BOR

Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177

LONG FOCAL LENGTH LARGE MIRROR FABRICATION SYSTEM

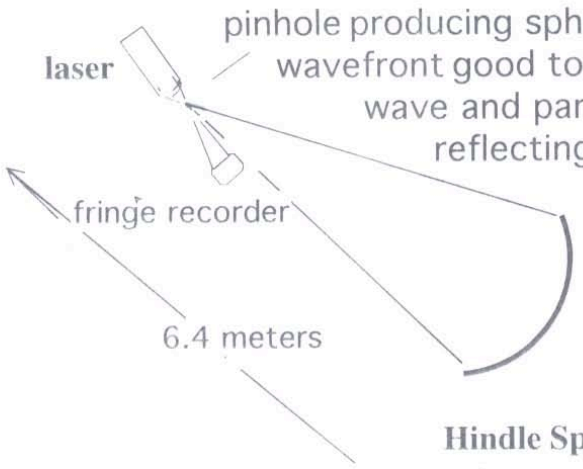
Harold E. Bennett
Bennett Optical Research Inc.
201 N. Sanders Street
Ridgecrest, CA 93555
(760)384-1177
bennett@bennettopticalresearch.com

BOR

BOR Optical Figure Test Facility

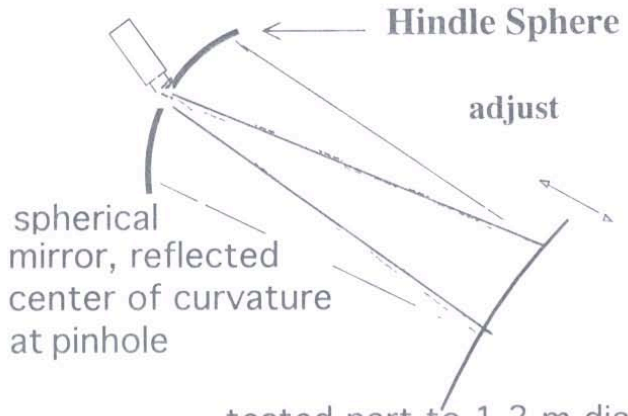
Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177
bennett@ridgenet.net

Fabrication of Hindle Sphere



Hindle Sphere
0.8 meter diameter
f/4, in fabrication

Figure test of composite optics mandrels, etc.



tested part to 1.2 m diam
convex or concave,
double reflection increases sensitivity of test

Long Focal Length Large Mirror Fabrication System

NASA Phase II Program, Bennett Optical Research Inc.

Goals:

1. make and measure large composite adaptive optics mirrors
2. develop low scatter polishing using centrifugal elutriation
3. develop scatter measuring system
4. develop Hindle sphere system to measure one meter mandrel
5. build large composite adaptive optic mirrors

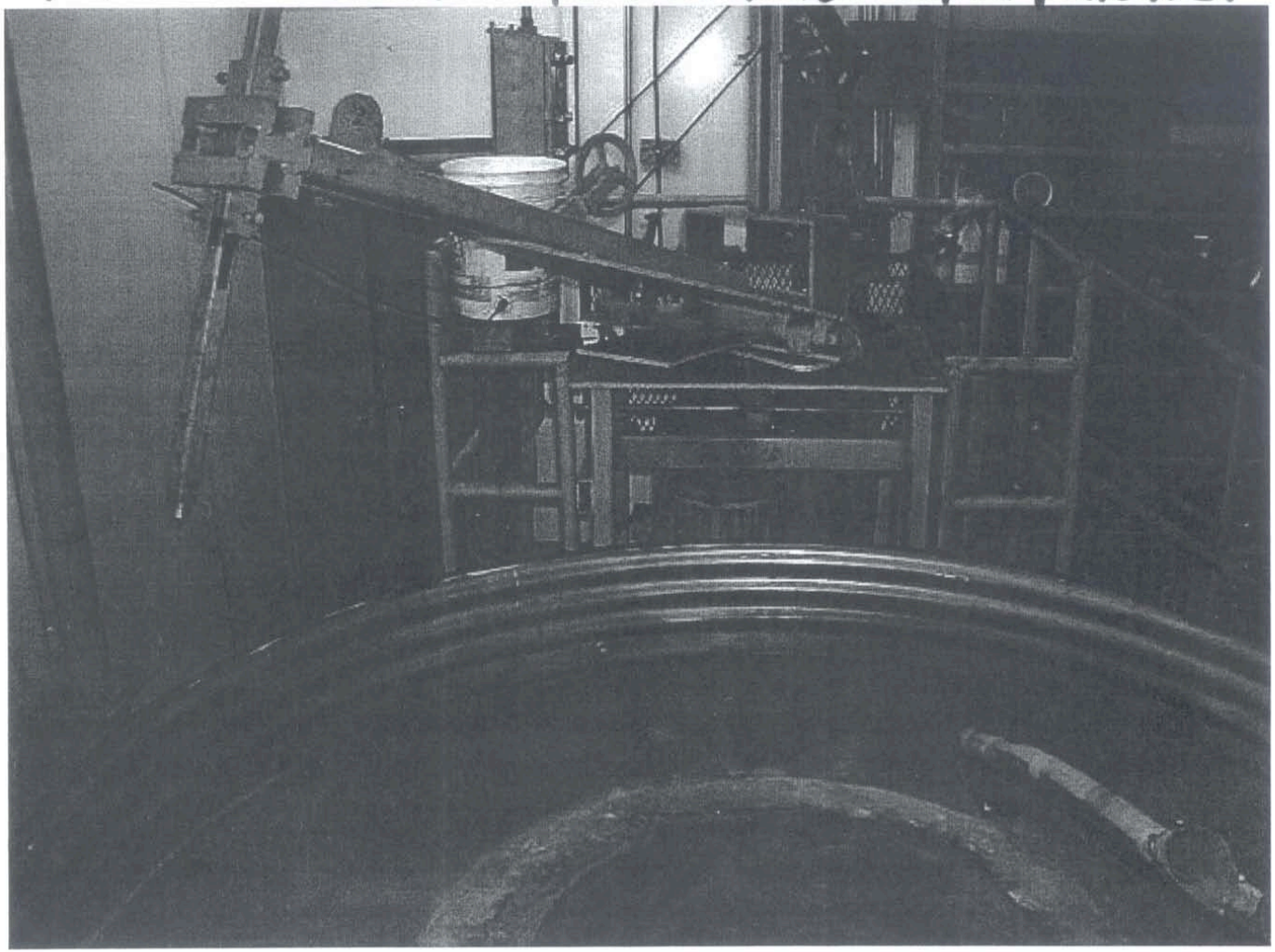
Deliverables:

1. 30 cm diameter super-polished composite AO mirror
2. 55 cm diameter super-polished composite AO mirror

Contract Period and Funding:

1. Contract period 1/15/02 - 1/15/04 (all goals will be met)
2. Funding - $600 K
3. COTR John Rakoczy, NASA/MSFC

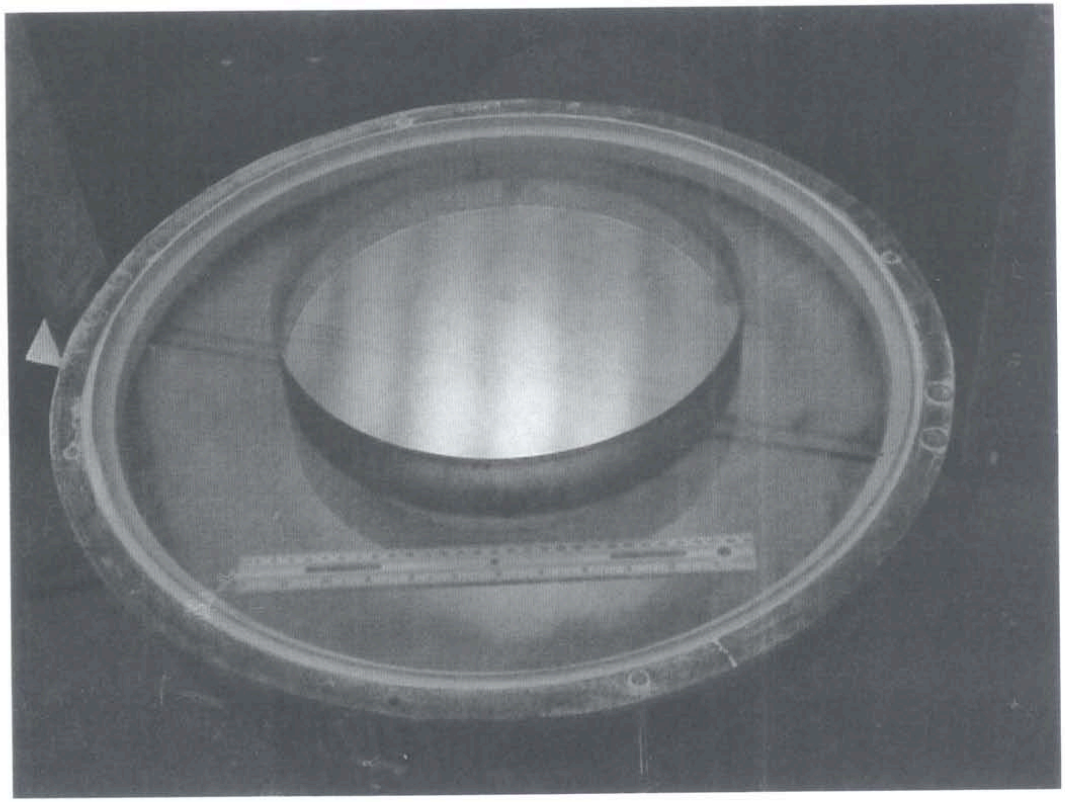
1.4 Meter Centrifugal Elutriation Superpolisher

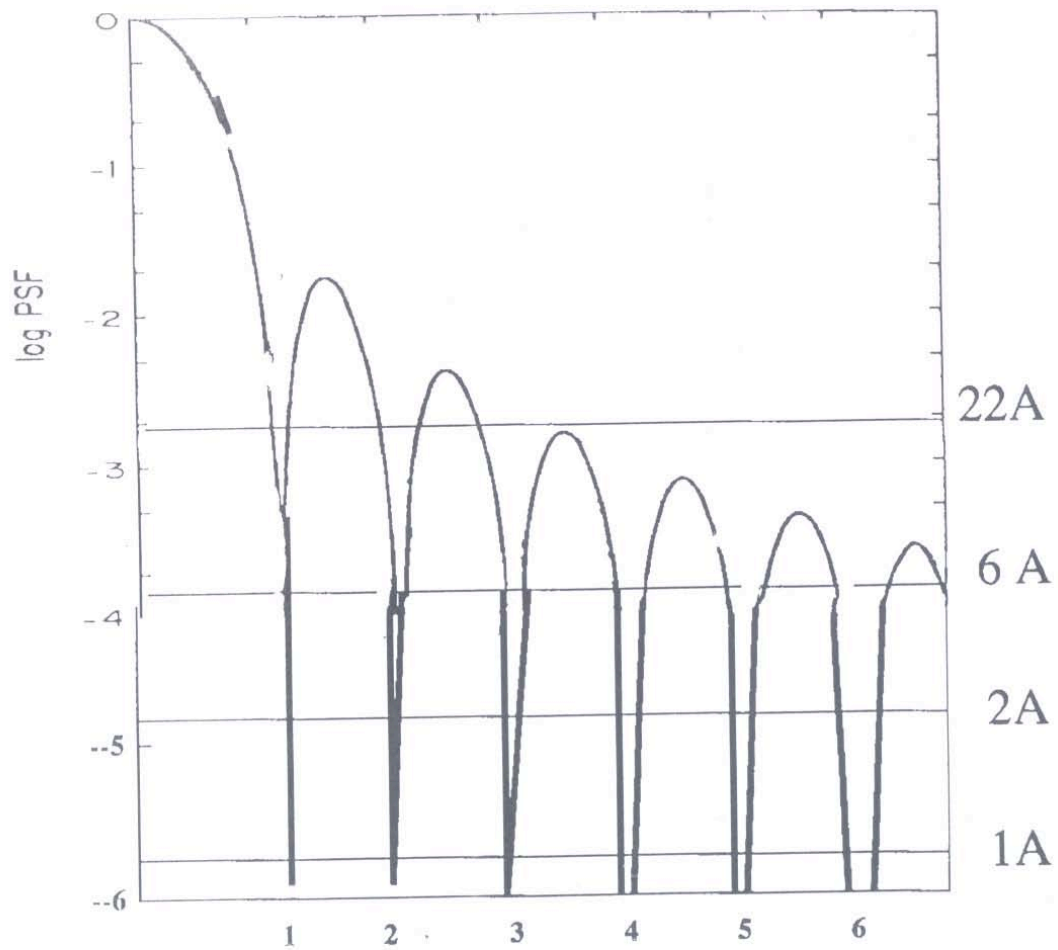


BOR

0.53 meter superpolished 1/20th wave mandrel

Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177
bennett@ridgenet.net




log PSF
0
-1
-2
-3
-4
--5
--6
1
2
3
4
5
6
22A
6 A
2A
1A

BOR

BOR and CMA mfg facilities for AO mirrors

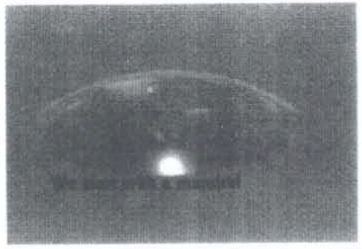
Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177
bennett@ridgenet.net

- Process to make mirrors
- Mandrel manufacture at BOR
- Faceplate transfer mirrors fabrication at CMA
- Assembly of faceplate and actuators and testing at BOR

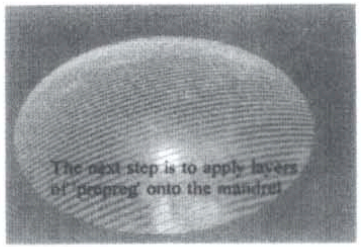
Composite Replica Mirror Fabrication

1. Start

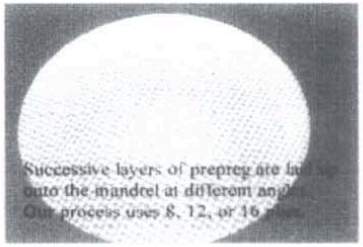
2. Prepare Mandrel



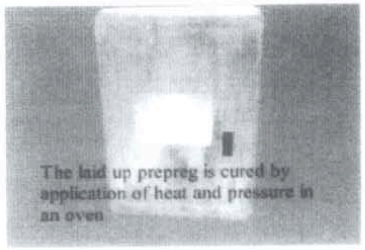
3. Layup 1 Ply



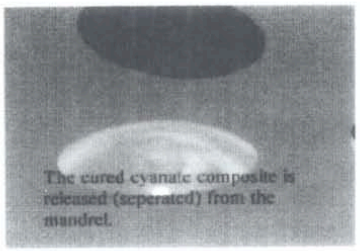
4. Multiple Plies



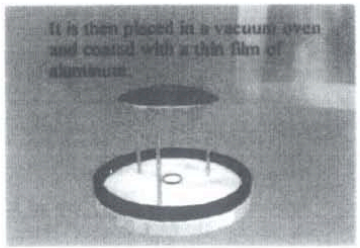
5. Cure Cycle



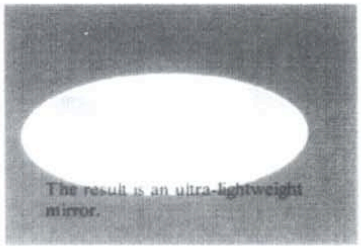
6. Release From Mold



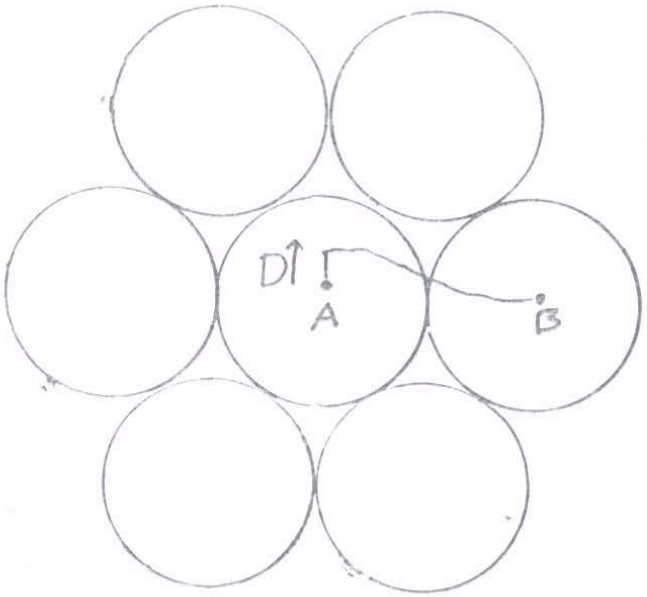
7. Vacuum Coat

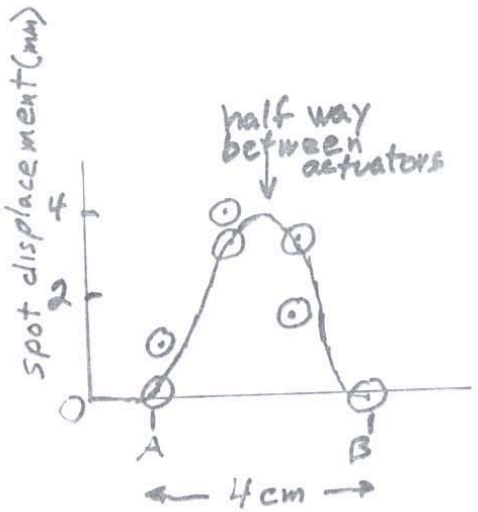


8. Finished Mirror

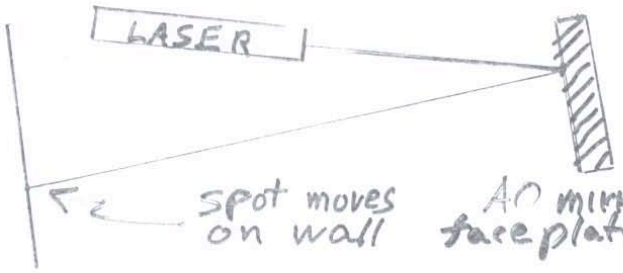


Demonstration that influence fcn is ~equal to actuator separation





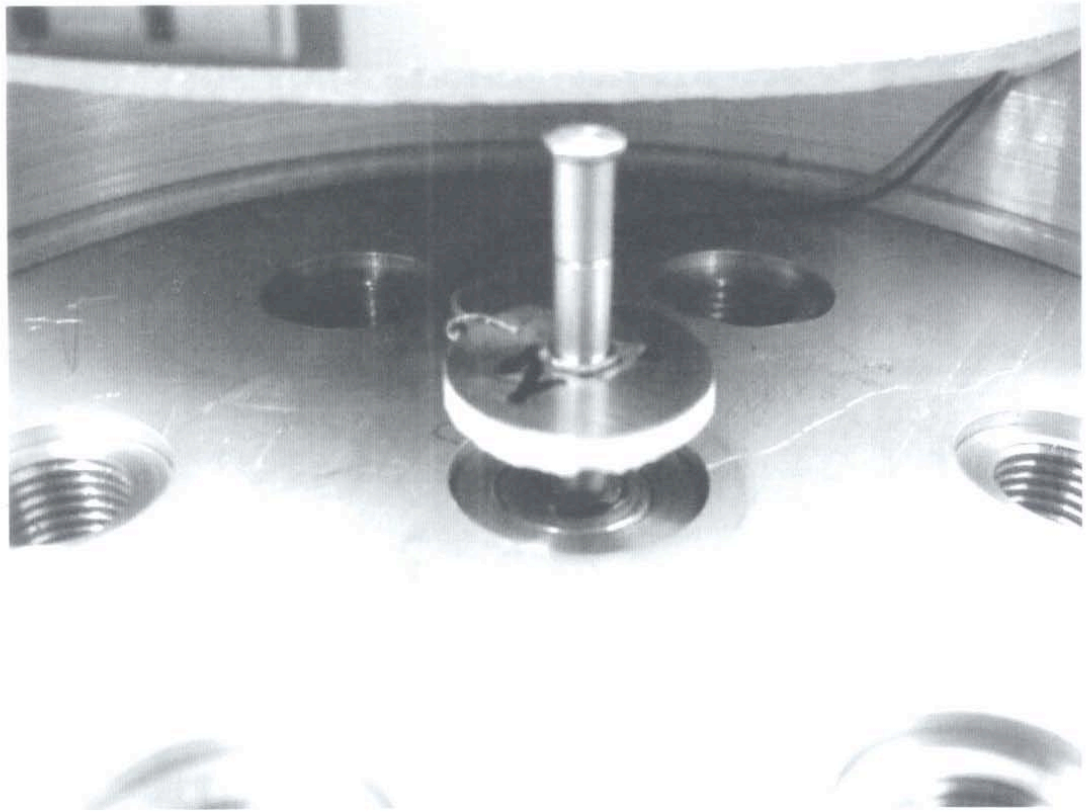
max spot displacement ~4mm
distance to wall 14' = 4270mm
max tilt $\frac{4}{4270} \cong 20$ arcsec
occurs ½ way between actuators ⇒ influence function ≅ actuator separation, 70V excitation



BOR

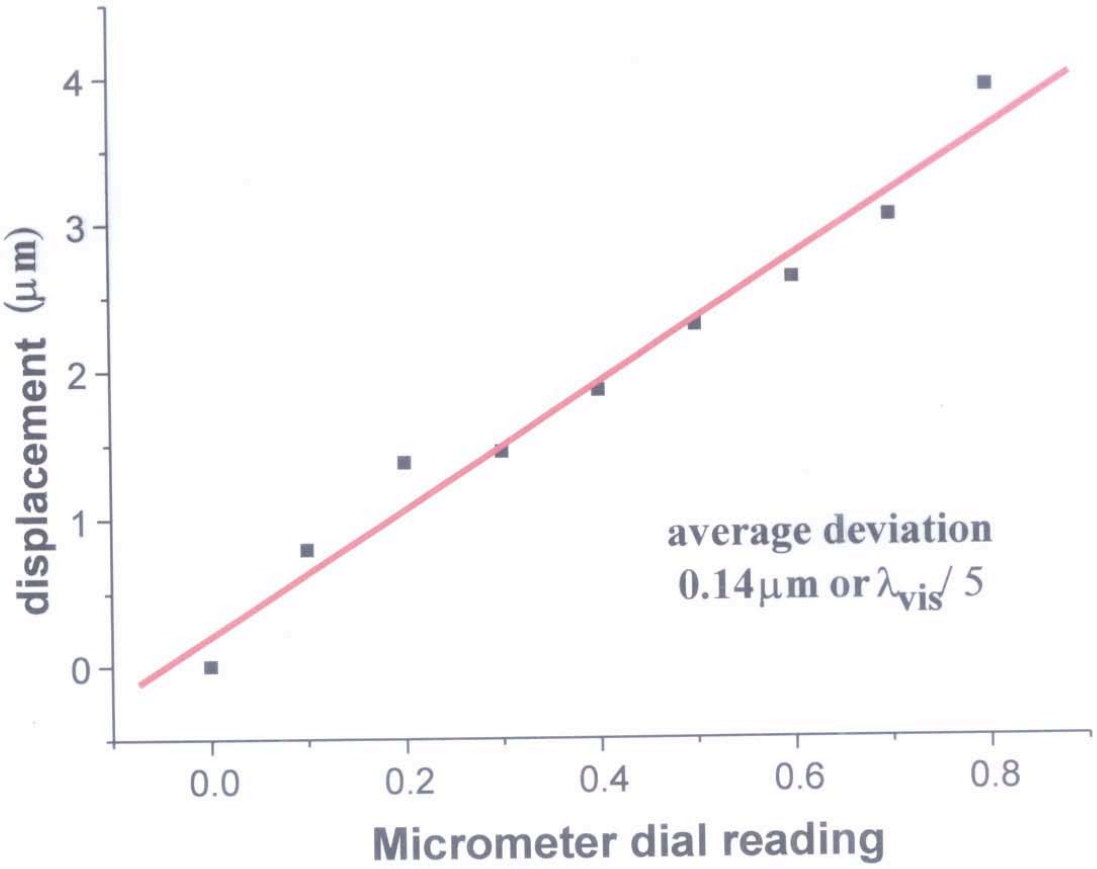
Closeup, Adjustable Mirror

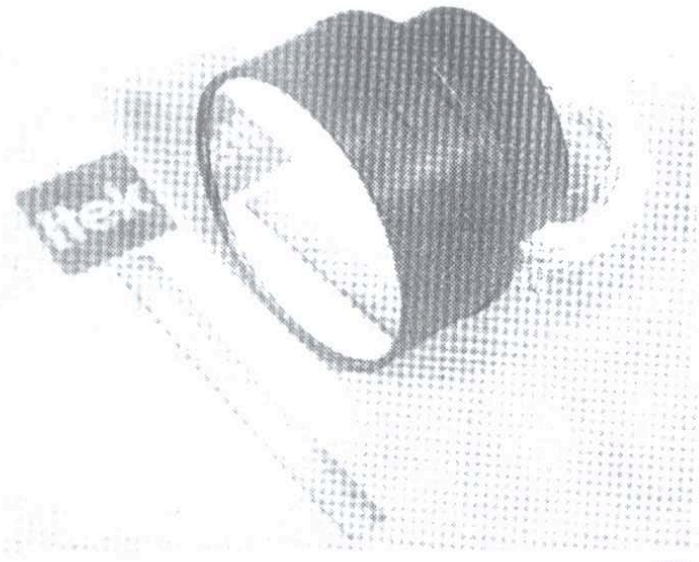
Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177
bennett@ridgenet.net



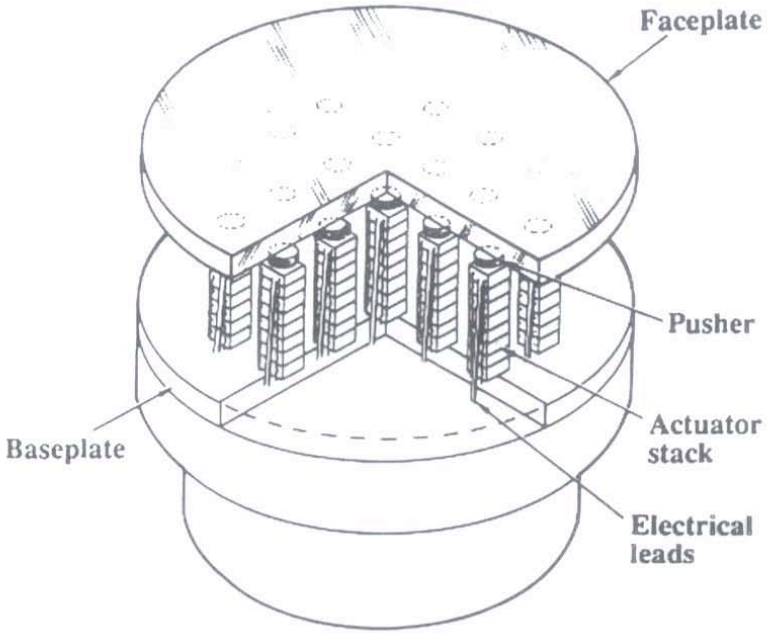
BOR

Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177
bennett@bennett
opticalresearch.com





26084

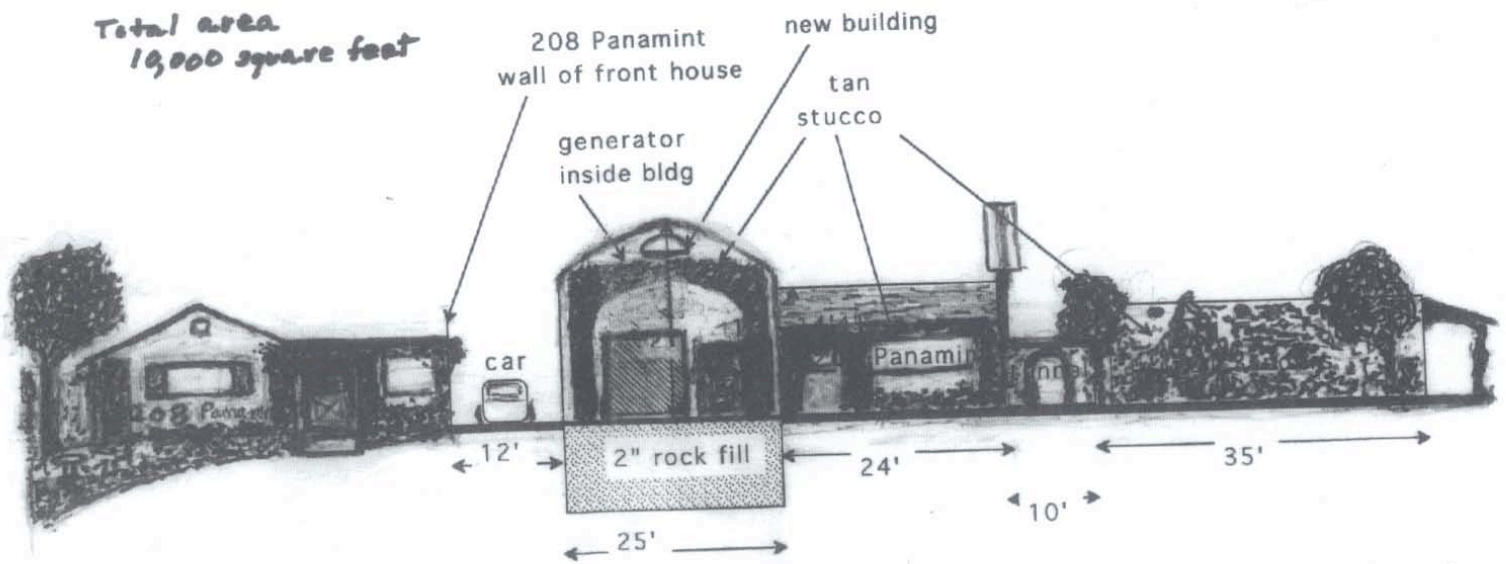


Features

• Controlled diameter	6.5 in.	• Stroke	±8μm
• Number of actuators	37	• Bandwidth	DC to 300 Hz
• Actuator spacing	1.1 in.	• Maximum voltage	1.5kV
• Sensitivity	55Å/V	• Mirror quality	0.25λp-p at 0.6 μm

VIEW FROM PANAMINT STREET OF BOR

Total area
10,000 square feet



BOR

Bennett Optical
Research, Inc.
Ridgecrest, CA
(760)384-1177

Bennett Optical Research Objectives

- Build up a large optics production and testing capability for glass and composite optics.
- Develop capability to superpolish low scatter mirrors of 1.2 meter diameter to less than 10A rms (auto correlation function measured over 65 waves).
- Develop capability to test mirrors of 1.2 meter diameter for figure to ~1/100 wave and for microroughness to ±1A rms at any point on the mirror.
- Develop capability to produce up to one meter diameter superpolished adaptive optic mirrors from graphite fiber cyanate resins with support from composite optics houses.

New large adaptive optic composite mirrors will be superpolished for low scatter, have good optical figure, light weight, low expansion and be relatively inexpensive